Annals of Clinical and Analytical Medicine
Original Research

Evaluation of incidental findings in patients undergoing computed tomography (CT) due to trauma

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Abstract
Aim: There are numerous studies reporting incidental findings in traumatic and non-traumatic patients undergoing imaging studies for various reasons. However, further studies are needed for the accumulation of evidence. Therefore, we conducted this retrospective study to analyse incidental findings in patients who underwent CT scans in our hospital due to trauma.
Material and Methods: This retrospective observational study included 1263 patients who were admitted to the emergency department of our hospital with the diagnosis of trauma and who underwent CT scans. Patients' demographic data such as age, gender and body mass, past medical history, type of trauma, mechanism of trauma, involved body part, length of stay in hospital and discharge status were analyzed. The incidental findings were divided into Class I, Class II and Class III based on the previous studies in the literature.
Results: The most common cause of trauma was found as falls at 65% followed by motor vehicle accidents (21%). The type of trauma was found as blunt in 425 (93.41%), penetrating in 7 (1.54%) and other in 23 (5.05) patients with incidental findings. The mean length of stay in the hospital was 9.2 ± 11.00 days in these patients. A total of 698 incidental findings were found in 455 patients, with 310 (68.30%) having one finding and 145 (31.87%) having more than one finding.
Discussion: We found the rate of incidental findings as 36.3%, consistent with many previous studies in the literature. It is crucial to communicate and document incidental findings and to prepare a proper follow-up schedule.

Keywords
Trauma, CT Scans, Incidental Findings, Incidentaloma, Follow-Up

DOI: 10.4328/ACAM.21086 Received: 2022-01-27 Accepted: 2022-03-09 Published Online: 2022-03-10 Printed: 2022-06-01 Ann Clin Anal Med 2022;13(6):674-678
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Introduction

Trauma is among the leading causes of morbimortality worldwide. Trauma remains the leading cause of mortality among teenagers and a major reason for morbidity and mortality among elderly, and is a growing concern and important public problem [1]. Between 2006 and 2012, there have been nearly 200 million traumatic injuries discharged from emergency departments across the USA [2].

Advancements in computed tomography (CT) technology provided significant improvements such as decreased scan times (less than 1 minute) and high-quality thinner slices (< 1 mm) [3]. CT is the gold standard for the assessment of solid organ injury following trauma and is widely used as an imaging modality because of its ability to mainly demonstrate trauma-related thoracic, abdominal, cranial and cervical abnormalities in detail [4]. CT scans provide not only information about acute trauma-induced injuries, but also reveal pathologies that are not associated with trauma and are called 'incidental findings' [5]. The use of CT has improved the immediate diagnosis of injuries as well as increased detection of incidental findings [6]. With the widespread use of imaging modalities, the prevalence of both traumatic and non-traumatic incidental findings has increased. Therefore, detection of serious illness at an earlier asymptomatic stage, survival can be increased and mortality decreased [7]. The frequency of incidental findings depends on the examination modality, field strength and sequence as well as a patient cohort. Studies in the literature have reported clinically significant incidental findings between 3.5-16.5% in trauma patients [8]. In fact, because of the comprehensive nature of CT scanning, incidental findings are found on almost all CT scans performed for various reasons in a radiology department [9].

On the other hand, concerns have been raised about communicating incidental findings to patients and/or relevant specialties, and there is ongoing debate in the literature on this issue [10]. Furthermore, these findings also increase patients' anxiety and healthcare costs because of additional investigations undertaken [11]. Since the rapidly advancing image resolution is driving a surge in incidental findings. The frequency of such findings is increasing day by day because of the rapidly advanced improvements in the duration and section thickness, i.e. resolution of CT scans.

In order to find answers to the raised concerns and questions on incidental findings, first of all, the prevalence of incidental findings should be investigated and these findings should be discussed in detail. There are numerous studies reporting incidental findings in traumatic and non-traumatic patients undergoing imaging studies for various reasons. However, further studies are needed for the accumulation of evidence on the problem to achieve national and international consensus. Therefore, we conducted this retrospective study to analyze incidental findings in patients who underwent CT scans in our hospital due to trauma.

Material and Methods

Study Design and Patients

Before beginning, the study protocol was approved by the Ethics Committee of our hospital with the 15/09/2020 dated and 77 numbered decision. Patient consent was waived since the study was retrospective. The study was performed in line with the ethical principles of the Declaration of Helsinki (DoH).

This retrospective observational study included 1263 patients who were admitted to the emergency department of our hospital with the diagnosis of trauma with various underlying mechanisms and who underwent CT scans between 2018 and 2020. Study data were collected from the patient files in the electronic medical records system. Patients who underwent CT scans of the whole body, head, cervical spine, chest, abdomen and pelvis were included in the study.

Patients' demographic data such as age, gender and body mass, past medical history (smoking status, alcoholism, comorbidities, smoking, previous surgeries), type of trauma (blunt vs penetrating), mechanism of trauma (fall, motor vehicle accident, pedestrian injury, gunshot wound, assault, stab, other), involved body part, injury severity score, length of stay in hospital and discharge status were recorded and analyzed. Patients aged under 18 years and above 75 years, who did not undergo CT scans, those with poor scanning range and patients with missing data in the reports were excluded from the study. In addition, normal anatomic variations and artifacts were excluded. The frequency of incidental findings, length of hospital stay and subsequent interventions for the incidental findings during 1-year follow-up were also recorded. CT scans were performed by experienced radiologists.

Evaluation of Incidental Findings

The CT scans were retrospectively reviewed for the presence of reported incidental findings. A total of 1,500 patient files involving CT reports with images and other information were reviewed, and 237 reports with exclusion criteria were excluded from the analysis. The remaining 1263 reports were subjected to analysis. An incidental finding was defined as any finding not related to traumatic injury. Accordingly, 455 (36.03%) CT reports were found to have incidental findings. The incidental findings were divided into three main groups based on the previous studies in the literature [7, 12-14]:

Class I: minor degenerative, non-degenerative, congenital findings that do not require further investigation

Class II: findings do not require emergency intervention, but require follow-up within 3 months to 1 year

Class III: findings that require urgent investigation before discharge from hospital or soon after discharge

Statistical Analysis

Data obtained in this study were statistically analyzed using SPSS version 26.0 (SPSS, Statistical Package for Social Sciences, IBM Inc., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation and categorical variables as frequency counts and percentages. The relationship between the incidental findings and the age and gender of the patients was evaluated using the independent sample t-test. P-values <0.05 were considered statistically significant.

Results

A total of 1500 patient files were reviewed and 1263 reports who met the inclusion criteria were selected for further analysis. Two hundred and thirty-seventh reports were excluded because of the exclusion criteria. Out of those 1263 patients,

455 (36.03%) were found to have incidental findings on CT, with about 1/3 of them having more than one incidental finding (145, 31.87%).

The mean age of the patients was 56.5±23.07 years in all patients and 64.01±25.2 years for the patients with incidental findings. Incidental findings were further analyzed in patients aged >65 years to determine the effect of age on the frequency of incidental findings. Of the patients, 525 (41.57%) were aged over 65 years. The frequency of incidental findings was not statistically different between the genders (p>0.05). But it was statistically significantly higher in patients aged ≥ 65 years compared to younger patients (for both, p<0.001). Demographic characteristics of the patients with incidental findings on CT scans are given in Table 1.

When baseline clinical characteristics of the patients were examined, 160 (35.16%) of the patients were active smokers and 15 (3.27%) were alcohol abusers. The distribution of the comorbidities in the patients with incidental findings is shown in Figure 1.

The most common cause of trauma was found as falls at 65%, followed by motor vehicle accidents at 21%. The distribution of the mechanisms underlying trauma in patients with incidental CT findings is presented in Figure 2.

The type of trauma was found as blunt in 425 (93.41%), penetrating in 7 (1.54%) and other in 23 (5.05) patients with incidental findings. Injury severity score (ISS) was found as 14.5±6.7 in all patients and 13.2±6.6 in patients with incidental findings. The number of CT scans was found as 433 (95.16%) of the head, 270 (59.34%) of the chest, 402 (88.35%) of the abdomen/pelvis and 214 (47.03%) of the whole body. A total of 173 (38.02%) patients with incidental findings required ICU admission due to trauma. The mean length of stay in the hospital was found as 9.2 ± 11.00 days in these patients. Whereas 15 (3.30%) patients died in the hospital, 238 (52.31%) patients were discharged home, and the other 202 (44.40%)

Table 1. Demographic features of the patients with incidental CT findings

	Overall (n=1263)	Incidental Findings (n=455)
Characteristics		
Age (years)	56.5±23.07	64.01±25.2
Elderly (≥65 years)	525 (41.57%)	248 (54.51%)
Gender		
Male	755 (59.78%)	249 (54.73%)
Female	508 (40.22%)	206 (45.27%)
Body Mass Index	26.7 ± 6.2	25.8 ± 8.5

Table 2. Classification of the incidental findings on CT scans

Class I	**105**	**15.04%**
Polyps / Cysts	21	3,01
Bladder Diverticulum	14	2,01
Duodenal Diverticulum	12	1,72
Accessory Spleen	7	1
Horseshoe Kidney	5	0,72
Bovine Aortic Arch	5	0,72
Undescended Testicle	3	0,43
Other	38	5,44
Class II	**468**	**67,05**
Kidney Cyst	112	16,05
Renal Calculi	22	3,15
Lung Nodule	92	13,18
Thyroid Nodule	52	7,45
Adrenal Nodule	42	6,02
Ovarian Cyst	21	3,01
Hepatic Cyst	17	2,44
Spleen Hemangioma	15	2,15
Hiatal Hernia	12	1,72
Prostate Enlargement	8	1,15
Hydrocele	4	0,57
Other	71	10,17
Class III	**125**	**17,91**
Kidney Lesions	25	3,58
Liver Lesions	20	2,87
Pancreatic Lesions	18	2,58
Brain Lesions	14	2,01
Lung Lesions	11	1,58
Breast Lesions	7	1
Colon Lesion	3	0,43
Pelvic Lesion	3	0,43
Mediastinal Lymph Nodes	3	0,43
Abdominal Aortic Aneurysm	3	0,43
Other	18	2,58

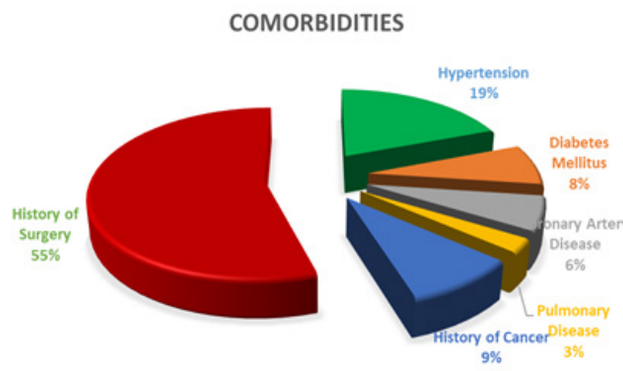

Figure 1. Comorbidities of the patients with incidental findings in CT scans

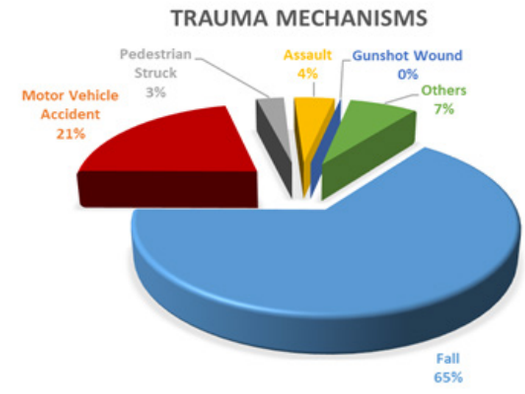

Figure 2. Distribution of trauma mechanisms in patients with incidental findings

patients were referred to other services. Only 67 (14.73%) of the patients with incidental findings continued to follow-up visits. A total of 698 incidental findings were found in 455 patients with 310 (68.30%) having one finding and 145 (31.87%) more than one finding. The distribution of the incidental findings according to the classes is given in Table 2.

Discussion

Patients being evaluated for traumatic injury often undergo CT scans performed in the head, cervical spine, chest, abdomen, pelvis or whole body. CT scans are an excellent imaging modality to identify traumatic injuries as well as to detect other pathologic conditions that are not related to trauma, which are called "incidental findings" or with a novel term "incidentalomas". This, of course, raises the question of how best to handle the additional information obtained.

In the present study, we investigated the incidence and characteristics of incidental findings in patients undergoing CT scans due to trauma. We found the incidence of these findings as 36.3%. In other words, approximately 1.8 of each 5 CT scans revealed incidental findings. This finding is similar to the results of previous studies. In their study on incidental findings on CT scans in the emergency department, Thompson et al. reported the incidence of incidental CT findings as 33.4%. This rate was reported as 40% in a study by Andrawes et al., examining a total of 1000 CT scans [14]. Other studies in the literature also reported similar results [6, 12].

As expected, the most common CT incidental findings were detected in abdomen/pelvis region, while the least common findings were in the head region despite the highest rate of CT scans of the head. In our study, incidental findings were defined as Class I in 105, Class II in 468 and Class III in 125 scans. The highest rate was found in Class II findings that required follow-up visits within 3 months to 1 year. However, when these findings were further investigated, it was found that there was no need for urgent diagnostic or therapeutic studies before discharge. On the other hand, as many authors report in the literature, we also think that incidental findings should be communicated to the patient or their families and documented [14, 15]. Studies have shown that proper follow-up visit planning at the initial visit decreased the number of patients lost to follow-up [16].

In our study, we did not find a significant difference between the two sexes in terms of the rate of incidental findings ($p>0.043$). Likewise, Barboza et al. did not find an association between gender and incidental findings, while some studies reported female dominance [17]. The difference might be resulted from the study populations included.

It is obvious that incidental findings are associated with aging, namely a higher rate of these findings are expected to be detected in older patients. In the present study, patients aged ≥ 65 years had a much higher rate of incidental findings compared to the younger patients. In this age group, 54.51% of all incidental findings were detected. Barboza et al. reported a higher rate of incidental findings at cervical spinal CT of traumatically injured patients, especially among older patients [17].

We also found insufficient follow-up documentation of the patients with incidental findings, and could not include assessment of the follow-up documentation in our study due to missing data. In a study by Munk et al., 43% of trauma patients had incidental findings on CT scans of the abdomen and pelvis, and only 27% of those had documentation of the findings [13]. It would be more reasonable to closely follow up these patients not to miss the opportunity of early diagnosis and therapy and increasing the chance of survival. In our study, only 14.73% of the patients visited our hospital for follow-up. This rate is similarly low in previous studies with Andrawes et al. reporting this rate as 10% [14].

Study Limitation

This study has several limitations. Major limitations of the study include its retrospective design and being conducted in an emergency department of a single center. Thus, the results cannot be generalized. In addition, incidental findings could not be analyzed according to the body regions in more detail. Variables could be compared with the trauma patients without incidental findings. Furthermore, we could not evaluate the follow-up process of the patients with incidental findings due to missing documentation. We believe that our findings will contribute to the accumulation of evidence for incidental findings. Further prospective multicenter studies with long-term follow-up of the patients with incidental findings are urgently needed.

Conclusion

Incidental findings are common on CT scans performed to evaluate injuries in trauma patients because almost all patients with a traumatic accident undergo CT examination. We found the rate of incidental findings as 36.3%, consistent with many previous studies in the literature. It is crucial to communicate and document incidental findings and to prepare a proper follow-up schedule.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

Funding: *None*

Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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How to cite this article:
Ayse Cetin, Serkan Altuntas, Isil Yurdaisik. *Evaluation of incidental findings in patients undergoing computed tomography (CT) due to trauma. Ann Clin Anal Med 2022;13(6):674-678*